Ontario

Ministry of Municipal Affairs and Housing

Ministry of Energy

ENERGY CONSERVATION BUILDING OPERATIONS DEMONSTRATION FOR GAS-HEATED HIGH-RISE MULTIPLE-UNIT RESIDENTIAL BUILDINGS

ENERGY CONSERVATION
BUILDING OPERATIONS DEMONSTRATION
FOR
GAS-HEATED HIGH-RISE MULTIPLE-UNIT
RESIDENTIAL BUILDINGS

Project Undertaken Jointly by the

Ontario Ministries of Municipal Affairs and Housing and Energy

under the Housing Energy Management Program (HEMP)

Prepared for the Ministry of Municipal Affairs and Housing

Technical Services Division

Research and Development Section

by

ENGINEERING INTERFACE LIMITED

May 1982

ISBN 0-7743-7507-8

ENERGY CONSERVATION

BUILDING OPERATIONS DEMONSTRATION PROJECT

FOR

TWENTY GAS-HEATED HIGH-RISE MULTIPLE-UNIT RESIDENTIAL BUILDINGS

PART I

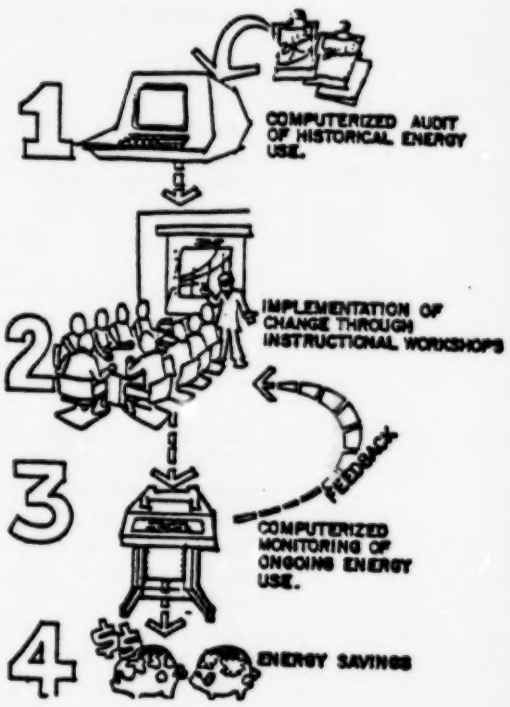
EXECUTIVE SUMMARY

TABLE OF CONTENTS

		Page
1.	Description of the Project	Part I-1
2.	Results	Part I-2
3.	Conclusions	Part I-2
	Fig. 1 - Energy Use Summary	Part I-3
	TABLE 1 - Costs and Savings for the Demonstration Project	Part I-4
4.	Issues	Part I-5

1. Description of the Project

In September 1980, a group of association representatives from the condominium and rental residential apartment sector attended a briefing session to learn of an instructional energy management pilot project managed by the Ontario Ministry of Municipal Affairs and Housing and funded by the Ministry of Energy under the Housing/Energy Management Program (HEMP). This demonstration was undertaken to gauge the effectiveness of using a system of audits of past years' energy data from utility bills, workshops to train building owners and managers, and monitoring of ongoing consumption in high-rise residential buildings. The Ministry covered the audit, workshops and monitoring fees; building owners were required to supply suitable personnel for the program, to ensure that necessary work was carried out, and to pay for costs incurred to implement required changes within the building. These costs were limited to a maximum of $5,000.



Groups of owners, managers and superintendents representing a total of ten rental and ten condominium buildings assembled for the first workshop in November 1980. Between then and May 1981, they returned at approximately one month intervals to continue the learning process and to review their successes with other workshop participants and facilitator. The selection of energy measures to implement was assisted by the computerized audits of historical energy use in the buildings, and the effectiveness of the measures was tracked by computerized monitoring of ongoing energy use.

Buildings for the demonstration project were selected on a first come first served basis and limited to those meeting the following criteria:

(a) Condominium or rental forms of ownership (ten of each).

(b) Over 100 units in size.

(c) Gas-fired space heating system.

(d) Availability of past years' energy data.

(e) Willingness to participate in workshops, review of the project, and undertake implementation of cost effective energy measures up to a maximum total expenditure of $5,000.

This report describes the workings of the demonstration project, details the first year's results, and outlines several unresolved issues which arose. It will be supplemented by a second report, late in 1982.

2. Results

Results are presented in terms of energy use in the year prior to the start of the project (September 1979-August 1980), and savings in the first year of the project. Figure 1 summarizes changes in energy use, while Table 1 displays dollar costs and savings.

The monitoring information has been adjusted for billing period and weather differences between the current year and the reference year. This provides a direct comparison of savings with actions undertaken.

Overall energy use for condominiums and rentals for this first year was reduced by 4.5 percent and 6.8 percent respectively. Of the buildings which completed the project, six of the nine condominiums achieved savings, while eight of the nine rentals were successful. Failures among the condominiums were primarily due to human factors - lack of interest from the manager, the board or both. The one rental energy increase occurred in a building plagued with mechanical and electrical system problems; this building requires individual technical help which is now being arranged by the Ministry of Municipal Affairs and Housing.

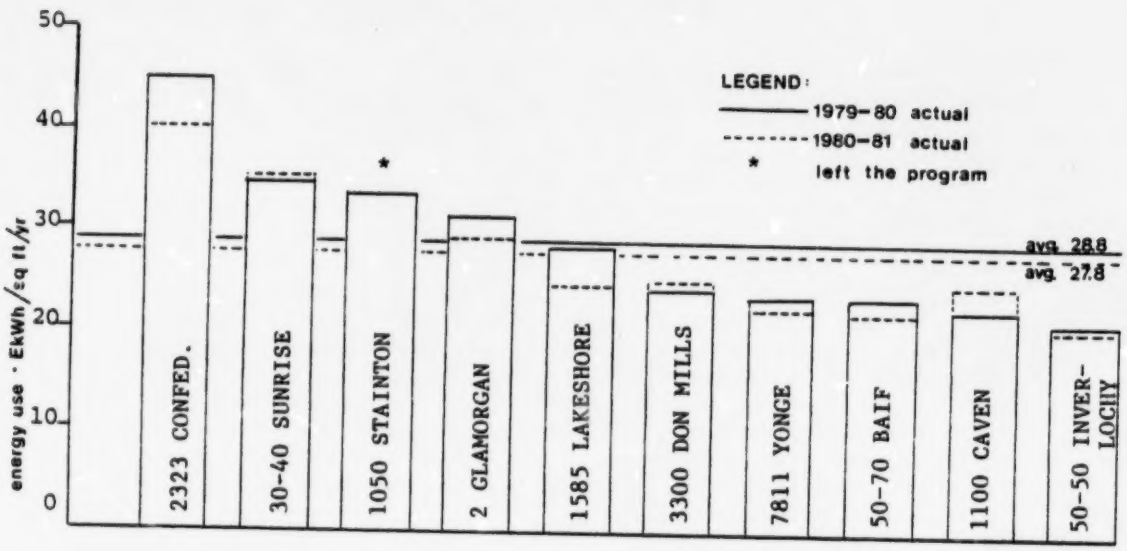
Savings shown for the buildings cover the year September 1980 to August 1981. The workshops began in December 1980 and were completed in May 1981. Results therefore relate to three months before, 6 months during and three months following implementation of change, and steady state savings in the second year are expected to be significantly higher.

3. Conclusions

This instructional approach to energy conservation is one of the effective ways for achieving lasting results. It involves large numbers of participants, makes best use of the skills of the instructor, and

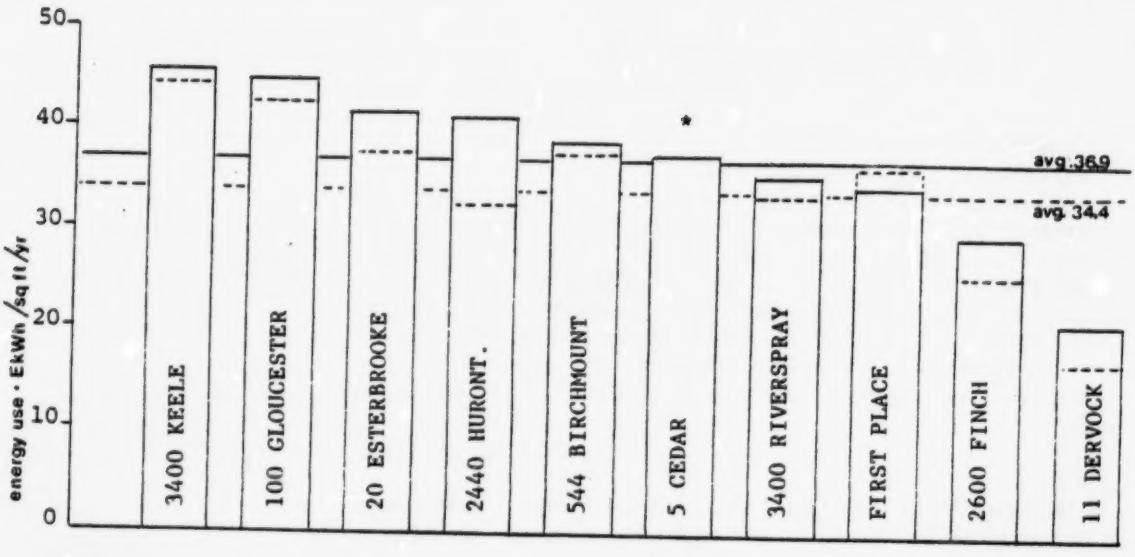
FIG. 1

Energy Use Summary



CONDOMINIUMS

7 248.7 MCF gas
244 900 kWh elec
} $28,180 aggregate first year savings



RENTALS

20 408.7 MCF gas
627 700 kWh elec
} $52,930 aggregate first year savings

TABLE 1

Costs and Savings for the Demonstration Project

Building	Cost $(1981)	Actual First Year Savings $(1981)
Condominiums		
2 Glamorgan	2,900	5,180
50/60 Inverlochy	13,500	3,750
50/70 Baif	est. 1,000	7,610
1050 Stainton	*	*
1535 Lakeshore	900	12,660
1100 Caven	Nil	(3,300)
30/40 Sunrise	1,200	(1,010)
2323 Confederation	1,500	2,690
7811 Yonge	100	3,250
3300 Don Mills	est. 900	(2,650)
	22,000	28,180
Rentals		
544 Birchmount	3,800	1,350
First Place, Hamilton	300	(6,300)
2600 Finch	500	5,110
100 Gloucester	3,800	3,140
3400 Keele	est. 800	930
20 Esterbrooke	3,500	5,980
11 Dervock	4,100	6,630
5 Cedar	*	*
3400 Riverspray	est. 2,800	21,530
2440 Hurontario	1,250	14,560
	20,850	52,930
Consulting fees for Workshops, for computerized Audits and Monitoring of energy use for 1 year	56,000	
Totals	98,850	81,110

* Left the program

provides managers and operators of buildings with the knowledge to competently perform energy related aspects of their work. It provides a healthy learning environment by promoting competition and by establishing a forum for sharing experiences among people with similar interests. It generates new ideas through the power of group discussion, identifies opportunities, and points to areas where changes can have positive results.

There was a stronger correlation of achievement with the level of effort applied by participants than with previous energy use levels by the buildings. For example, 11 Dervock was the lowest energy user per sq.ft. among the rental buildings, but still showed a 15 percent overall energy saving. 50/60 Inverlochy enjoyed the same status among the condominiums, and achieved a 5 percent saving. However, when the nominated participant for a building was unable to complete the series of workshops, replacements had extreme difficulty in making up lost ground. Seven of the ten condominiums changed managers or management companies during the course of the program, and in only one of those cases was the transfer achieved without one or more workshops being missed, and opportunities for saving energy thereby being delayed, or lost altogether. Two of the rental buildings were sold, resulting in no further action. In developing the workshop approach further, two major issues to be addressed are continuity of representation, and finding ways of reducing the time required from managers and operators to complete the work without detracting from the educational aspect of the process.

4. Issues

Many issues were raised by participants in the workshops, and the following were perceived to be having the greatest influence on energy conservation in high-rise apartment buildings:

- Rent Review

  The inability of a landlord to receive any or appropriate return on investment in energy conservation in a rental building subject to rent review was frequently cited as a major disincentive. Higher rent increase ceilings, accelerated capital write off and energy cost allowances in lieu of actual energy costs were proposed as corrective measures.

- Ventilation Codes

  Municipal regulations regarding airflows and operating periods of apartment ventilation systems

are highly variable. Enforcement would result in four times the energy use for a building in a municipality requiring high airflows and continuous fan operation compared with an identical building in a municipality allowing lower airflows and non-continuous fan operation. Amendments to the Building Code were proposed to clarify the situation.

- User Pays

The majority of high-rise apartment buildings are bulk metered for electricity, so users pay only indirectly. As a consequence, energy use within the suites is practically uncontrollable, and many instances of overuse were reported. Several managers and superintendents felt that bathroom and hallway lights are on all day in many apartments, and that there is no way of controlling illicit use of electric heaters to maintain suite temperatures far above legal requirements. Emphasis on development of inexpensive submetering hardware was among proposals to combat this problem.

ENERGY CONSERVATION

BUILDING OPERATIONS DEMONSTRATION PROJECT

FOR

TWENTY GAS-HEATED HIGH-RISE MULTIPLE-UNIT RESIDENTIAL BUILDINGS

PART 2

DETAILED ACCOUNT OF THE PROGRAM,

OF ITS RESULTS AND OF ISSUES WHICH AROSE

TABLE OF CONTENTS

		Page
2.1	The SUMAC Energy Management System	Part 2-1
	A. General Description	Part 2-1
	B. Audit Energy Breakdowns	Part 2-1
	Fig. 2.1 Energy Breakdowns	Part 2-1
	TABLE 2.1 Association Between Energy Systems & SUMAC Energy Use Components	Part 2-2
	C. Audit Weather Normalization	Part 2-2
	D. Audit Pattern Recognition	Part 2-2
	E. Workshops	Part 2-3
	Fig. 2.2 Comparison of Gas Use Response to Weather Variations for 2600 Finch	Part 2-4
	F. Monitor	Part 2-5
2.2	Energy Audits	Part 2-6
	TABLE 2.2 - SUMAC Building Energy Audit CONDOMINIUMS	Part 2-7
	TABLE 2.3 - SUMAC Building Energy Audit RENTALS	Part 2-8
	TABLE 2.4 - Summary of Building Characteristics	Part 2-9
	TABLE 2.5 - Energy Use Comparison Between Condominium & Rental Averages	Part 2-10
	TABLE 2.6 - Energy Usage Pattern Recognition	Part 2-11
2.3	Workshops	Part 2-12
	TABLE 2.7 - Systems Modified at the Buildings by Sept/1981 in order of Estimated Return on Investment	Part 2-13

TABLE OF CONTENTS

Page (contd)

TABLE 2.8 - Summary of the Project and its First Year Results.....Part 2-14 a&b

2.4 Monitor.....Part 2-15

2.5 Costs and Savings.....Part 2-15

Fig. 2.3 Summary of First Year Energy Savings CONDOMINIUMS.....Part 2-16
Fig. 2.4 Summary of First Year Energy Savings RENTALS.....Part 2-17
Fig. 2.5 Summary of First Year Energy Savings TOTAL (CONDOS+RENTALS).....Part 2-18
Fig. 2.6 Energy Use Summary.....Part 2-19

TABLE 2.9 - Summary of Costs & First Year Savings for the Demonstration Project.....Part 2-20

2.6 Issues Raised.....Part 2-21

a. Rent Review.....Part 2-21
b. Ventilation Codes.....Part 2-21
c. Property Management.....Part 2-21
d. Laundries.....Part 2-21
e. Electricity Metering for Suites.....Part 2-22
f. Unanswered Questions.....Part 2-22

2.1 THE SUMAC ENERGY MANAGEMENT SYSTEM

A. General Description

SUMAC is a family of computer programs designed to provide energy managment guidance through analysis of energy records. Over the past four years, SUMAC has been used to audit historical energy use for more than fifteen hundred buildings, including offices, shopping centres, retail stores, schools, hospitals and one hundred and fifty high-rise apartment buildings. The SUMAC System provides an Audit of historical energy records to provide direction; Action through workshops to teach building operators how to make improvements, and a Monitor of ongoing monthly energy records to provide feedback

B. Audit Energy Breakdowns

SUMAC draws patterns of energy use from monthly information, and derives eight components as illustrated in Fig. 2.1. The components are as follows:

1. Fuel - Non-weather sensitive.
2. Fuel - Weather sensitive.
3. Electricity - Base consumption (kilowatt hrs).
4. Electricity - Base demand (kiloWatts).
5. Electricity - Winter extra consumption (kWhrs).
6. Electricity - Winter extra demand (kW).
7. Electricity - Summer extra consumption (kWhrs).
8. Electricity - Summer extra demand (kW).

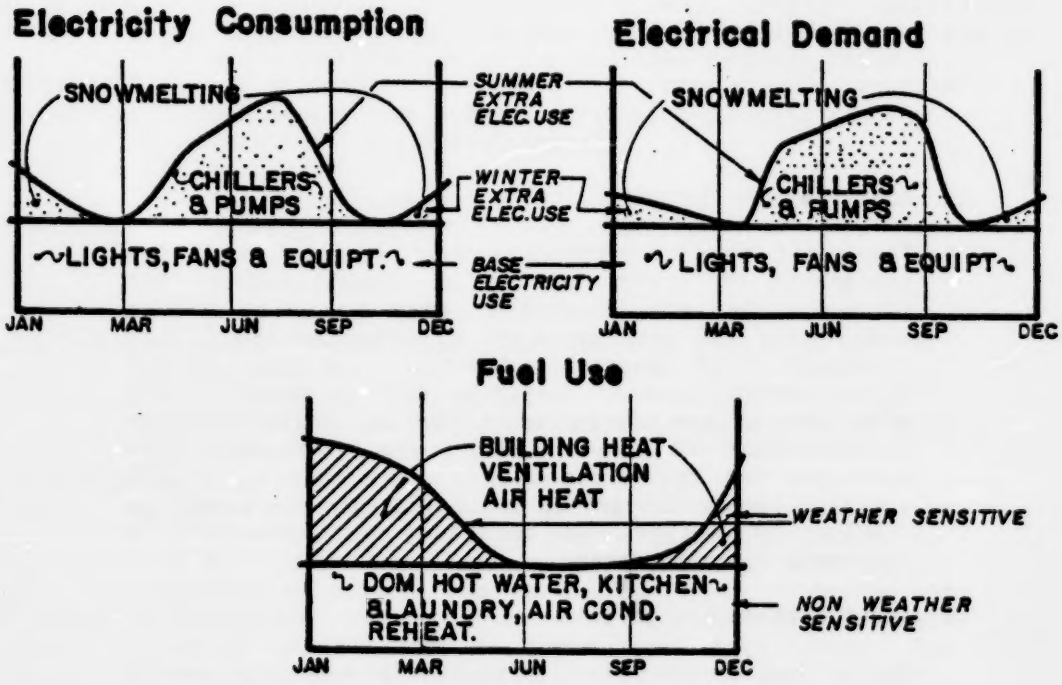


Fig. 2.1
Energy Breakdowns

Each energy use component is associated with size and operation of discrete groups of energy systems within the building. These associations between energy systems and SUMAC energy use components are outlined in Table 2.1. Components which are found to be abnormally high point to systems requiring attention to either the energy demands of the systems or, in the case of fuel, to efficiency of heat generation. The judgment of what constitutes abnormality in a particular energy component for a particular building is derived from comparison with other similar buildings in SUMAC's database.

TABLE 2.1

Association Between Energy Systems and SUMAC Energy Use Components

---- FUEL ----		-------- ELECTRICITY ----------		
Non-Weather Sensitive	Weather Sensitive	Base (Non-Seasonal)	Winter Extra	Summer Extra
.Domestic Hot Water	.Building Heat	.Lighting	.Electric Heat	.Air Conditioning
.Pool Heater	.Ventilation Heat	.Appliances	.Electric Snow-melting	.Lower Tenant Use(vacations provide negative component)
.Gas-Heated Driers	.Glycol Snow-melting	.Mechanical Equipment	.Longer Lighting	
.Incinerators	.Garage Heat	.Elevators .Pool Heater (year round)	.Greater Use of appliances	.Pool Heater used in summer only

C. Audit Weather Normalization

The audit program normalizes all weather sensitive components of energy use to a common weather base (Toronto, Ontario, standard year) to allow direct comparison of energy use by similar buildings irrespective of geographic location. Without weather normalization, weather sensitive fuel consumption, and often also winter extra electricity use, would be higher in cold areas and lower in mild areas. This would make averages for these components less meaningful and prevent direct comparison of buildings which may be similar in design and occupancy but situated in different climatic zones.

D. Audit Pattern Recognition

Energy use breakdowns indicate where excessive energy use is occurring, and therefore which systems require

attention. For example, where non-weather sensitive fuel consumption is higher than normal, a need for domestic hot water system changes is indicated. The program also draws graphics to show seasonal and weather responses of energy use. The manner in which actual monthly energy use is arranged around normal curves indicates specific problems with energy systems. Excessive fuel consumption in spring and fall becomes apparent, and indicates overheating in mild weather. Relative shapes of monthly electricity consumption and demand patterns speak to operation of electrical systems. For example, if winter months show high electricity consumption but relatively normal electrical demand, the implication of long ramp heater operation might be drawn. Inconsistencies in monthly fuel consumption related to weather (coldness) are indicators of boiler control problems. Fig. 2.2 shows the graphic for 2600 Finch, a building with severe control problems, compared with an unrelated apartment building, where all such problems have been corrected.

E. Workshops

Philosophy:

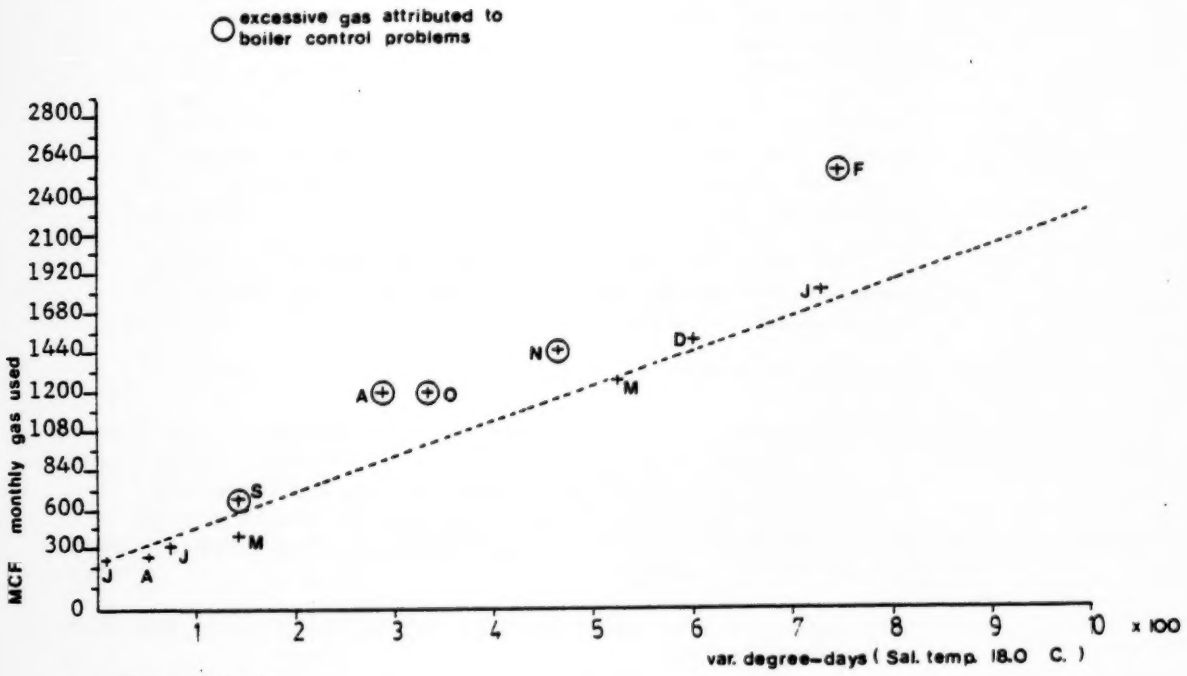
The philosophy behind workshops is to teach owners, managers and operators of buildings how to handle energy conservation themselves. Advantages of the approach include the following:

- Changes are more lasting since the implementer fully understands them.
- The building operator does not feel threatened as he would by intrusion of a consultant into his building.
- Consulting fees are lower for each building since the consultant's time is shared.
- The consultant is able to handle more buildings, thereby accelerating his acquisition of knowledge, and spreading that knowledge more rapidly and effectively.
- Participants share knowledge with each other as well as with the consultant.
- Healthy competition promotes the desire of each participant to do well.

In the introductory meeting, one or two representatives from each of ten buildings meet with the facilitator for a full day. They learn about the energy auditing and monitoring program and review the types of design and operational changes which will be considered for each energy using system in their type of building. The agenda is general rather than specific to each building, and the facilitator clearly explains preparatory work

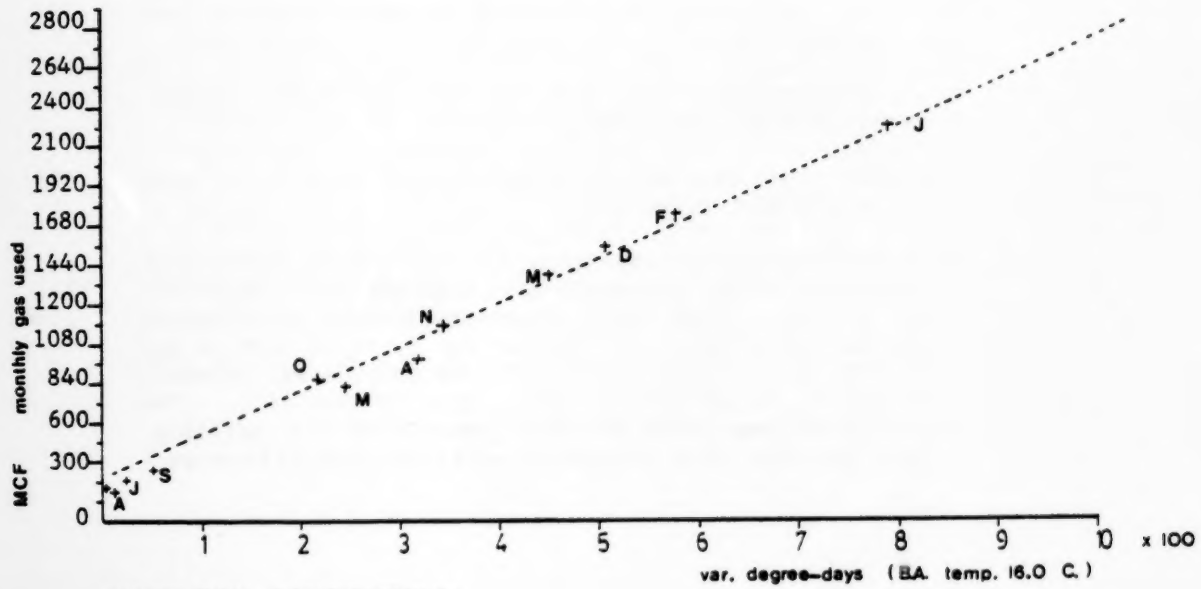
FIG. 2.2

COMPARISON OF GAS USE RESPONSE TO WEATHER VARIATIONS FOR 2600 FINCH (SUBSTANTIAL CONTROL PROBLEMS APPARENT) AND A CONDOMINIUM IN HAMILTON (NO CONTROL PROBLEMS APPARENT)



2600 FINCH

Aug. 79 - July 80



HAMILTON CONDOMINIUM

Sept. 80 - Aug. 81

required of the participants. This opening session is followed by six half day workshops at one month intervals each of which introduces a new topic and reviews progress with work arising from previous sessions. Five buildings are represented at each of these half day workshops, and the groups stay together for the duration of the project. The facilitator presents theory of design and operation for each energy system. He researches questions which cannot be resolved in the workshops. He liaises with appropriate equipment suppliers to obtain literature, samples and even discounts for participants. He moderates discussion between participants to help tailor prospective system changes to suit each building's needs. He is required to make the workshops orderly and enjoyable, and to listen and debate as well as to instruct. The workshops include visual material in overheads and 35 mm slides, a workbook, and ongoing written instruction in how to make changes to energy systems and how to calculate potential savings. Participants, who do not require any particular technical knowledge, are required to retrieve information about their buildings and to arrange for agreed changes to be implemented. They provide the essential practical experience to make the theory workable in each building and help each other to overcome problems with implementation.

F. Monitor

In addition to handling the initial energy audits, the SUMAC program's weather and billing period normalization capabilities are applied to monitor ongoing energy bills in order to determine each month the magnitudes of energy savings or increases. The monthly Monitor serves an essential feedback function in order to:

- reassure those doing the work and paying the bills that their endeavours are bearing fruit;
- provide early warning when unexpected results occur;
- encourage those who have yet to take action by displaying others' successes;
- show all participants the individual effects of sequential changes.

2.2 ENERGY AUDITS

The SUMAC Audits of energy use, generally for the 12 month period from September 1979 to August 1980, are presented in Table 2.2 and 2.3. Table 2.2 shows results for the ten condominiums; Table 2.3 shows equivalent data for the ten rental buildings. When reading the columns of information, look back to the system description in Section 2.1 to remind yourself of their meanings. Particularly high components are denoted with a †, while unusually low components are highlighted with an *. To help better understand the results, Table 2.4 shows major energy related characteristics of the buildings.

From the Audits, strengths and weaknesses of each building may be seen. For example, six of the rentals show non-weather gas use in excess of 10 ekWhr./sq.ft./year making them generally candidates for domestic hot water system modifications. While it is not suggested that all buildings will achieve per sq.ft. energy levels of the best performers, a degree of convergence was anticipated, with higher users generally expected to achieve greater savings than lower users. There was no perceptible tendency in this direction during the first year of the program as indicated in Table 2.8. The two highest energy users among the rentals both showed below average savings, while the lowest energy user from both rentals and condominiums showed above average savings.

A second, and rather interesting outcome of the audits is the comparison of rentals with condominiums. This comparison is summarized in Table 2.5. Both fuel use components are substantially lower on average in the condominiums, while all three electricity use components are higher. Overall energy use per sq.ft. in the condominiums was on average 22 percent lower than in the rentals.

TABLE 2.2

SUMAC

BUILDING ENERGY AUDIT

(Derived from Energy Use for 1979/1980)

CONDOMINIUMS

	ENERGY PERFORMANCE (EKWH/SF/YR)								DEMAND PERFORMANCE (WATTS/SF)				
	FUEL			ELECTRICITY					BILLING DEMAND				
BUILDING	NON-WEATHER SENSITIVE	WEATHER SENSITIVE	TOT	BASE	WNTR EXTRA	SUMMR EXTRA	TOT	GRAND TOTAL	BASE DMD.	BASE (HRS/WK)	WNTR EXTRA	SMMR EXTRA	TOT
2323 CONFED.	11.75†	19.57†	31.32†	9.78†	1.39†	1.12†	12.29†	43.61	2.04†	(92)	0.23†	0.12	2.39†
30-40 SUNR.	5.54	20.44†	25.98	6.95†	0.47	0.24	7.66	33.64	1.30	(103)	0.11	0.03	1.44
1050 STAIN.	8.63†	17.75†	26.38	3.99*	2.20†	0.94	7.13	33.51	1.14	(67)	0.23†	0.02	1.39
2 GLAMORGA.	7.37	16.77†	24.14	6.01	0.54	0.35	6.90	31.04	1.11	(104)	0.13	0.08	1.32
1535 LAKES.	8.37†	11.46	19.83	5.78	0.96	1.48†	8.22	28.05	1.07	(104)	0.12	0.21†	1.40
3300 DON M.	6.34	12.18	18.52	5.84	0.42	0.24	6.50	25.02	1.08	(104)	0.06	0.08	1.22
7811 YONGE.	3.84*	12.15	15.99	6.67	0.55	0.76	7.98	23.97	1.30	(99)	0.13	0.11	1.54
50-70 BAIF.	4.65*	10.94	15.59	6.47	0.34	1.23†	8.04	23.63	1.27	(98)	0.04	0.22†	1.53
1100 CAVEN.	6.72	10.95	17.67	4.13*	0.95	0.79	5.87	23.54	1.04	(76)	0.12	0.01	1.17
50-60 INVE.	6.28	7.62*	13.90*	5.95	0.96	0.95	7.86	21.76	1.28	(89)	0.11	0.12	1.51
AVERAGES	6.95	13.98	20.93	6.16	0.88	0.81	7.85	28.78	1.26	(94)	0.13	0.10	1.49

TABLE 2.3

SUMAC

BUILDING ENERGY AUDIT

(Derived from Energy Use for 1979/1980)

RENTALS

	ENERGY PERFORMANCE (EKWH/SF/YR)								DEMAND PERFORMANCE (WATTS/SF)				
	FUEL			ELECTRICITY					BILLING DEMAND				
BUILDING	NON-WEATHER SENSITIVE	WEATHER SENSITIVE	TOT	BASE	WNTR EXTRA	SUMMR EXTRA	TOT	GRAND TOTAL	BASE DMD.	BASE (HRS/WK)	WNTR EXTRA	SMMR EXTRA	TOT
3400 KEELE	13.50	23.70	37.20	7.60	0.40	0.10	8.10	45.30	1.50	(97)	0.10	0.00	1.60
100 GLOUCE.	10.60	29.40	40.00	3.70	0.70	0.00	4.40	44.40	0.80	(89)	0.00	0.00	0.80
20 ESTERBR.	7.70	27.20	34.90	4.70	0.50	0.00	5.20	40.10	0.90	(100)	0.20	0.00	1.10
2440 HURON.	13.00	19.90	32.90	5.70	0.60	0.60	6.90	39.80	1.20	(91)	0.00	0.00	1.20
544 BIRCHM.	10.80	20.10	30.90	6.40	1.00	0.20	7.60	38.50	1.30	(95)	0.10	0.00	1.40
5 CEDAR	10.90	21.60	32.50	4.70	0.50	0.10	5.30	37.80	1.10	(82)	0.10	0.00	1.20
3400 RIVER.	6.40	22.30	28.70	5.60	0.90	0.40	6.90	35.60	1.10	(98)	0.10	0.00	1.20
FIRST PLAC.	7.40	17.70	25.10	7.80	0.20	1.10	9.10	34.20	1.50	(100)	0.10	0.30	1.90
2600 FINCH.	10.70	14.80	25.50	4.60	0.60	0.10	5.30	30.80	1.00	(88)	0.10	0.00	1.10
11 DERVOCK	5.20	15.80	21.00	1.50	0.10	0.10	1.70	22.70	0.30	(96)	0.00	0.00	0.30
AVERAGES	9.62	21.25	30.87	5.23	0.55	0.27	6.05	36.92	1.07	(94)	0.08	0.03	1.18

TABLE 2.4

SUMMARY OF BUILDING CHARACTERISTICS

Address	Type	Age	No.of Suites	No. of Floors	Gross Occupied Area sq.ft.	Windows	Air Conditioning	Snow Melting	Exhaust Ventilation
CONDOMINIUMS									
2 Glamorgan t	Adult	1971	184	12	204,900	Single	50% Wind.A/C	None	Central
50/60 Inverlochy t	Mixed	1976	278	13/13	374,400	Double	Central	Elect.	Individual
50/70 Baif t	Family	Unknown	260	11/7	357,600	Double	Central	Glycol	Individual
1050 Stainton t	Family	-	114	6	153,200	Double	-	Elect.	Individual
1535 Lakeshore t	Family	1976	190	19	323,800	Double	Central	Elect.	Individual
1100 Caven t	Family	1975	162	14	230,000	Double	50%Wind.A/C	Elect.	Individual
30/40 Sunrise t	Family	1976	144	4	183,000	Double	50%Wind.A/C	Glycol	Individual
2323 Confederation t	Family	1971	105	14	112,000	Double	Central	Elect.	Central
7811 Family t	Adult	1974	149	13	203,700	Double	Central	Elect.	Individual
3300 Don Mills t	Family	1978	245	25	363,100	Double	40%Wind.A/C	Elect.	Individual
Sub Totals		1975(Av)	1,831		2,505,700				
RENTALS									
544 Birchmount t	Family	1964	120	11	125,500	Single	30%Wind.A/C	Elect.	Central
First Pl.Ham. t	Senior Citizens	1976	452	22	350,800	Double	25%Wind.A/C	None	Individual
2600 Finch	Family	1966	112	7	137,500	Single	10%Wind.A/C	Glycol	Central
100 Gloucester *	Adult	1957	205	11	114,400	Single	5%Wind.A/C	Glycol	Central
3400 Keele	Family	Unknown	141	9	121,600	Single	5%Wind.A/C	Glycol	Central
20 Esterbrooke	Family	1965	160	15	168,500	Single	15%Wind.A/C	Glycol	Central
11 Dervock *	Adult	1961	143	4	144,100	Single	None	None	Central
5 Cedar	Family	-	86	10	95,000	Single	10%Wind.A/C	Glycol	Central
3400 Riverspray	Family	1973	353	19	491,500	Single	15%Wind.A/C	Elect.	Central
2400 Hurontario	Family	1972	152	22	155,100	Single	10%Wind.A/C	Glycol	Central
		1967(Av)	1,924		1,904,000				
		1971(Av)	3,755		4,409,700				

* Individual suite electrical metering.
t Thermostatic control of heating in Suites.

Table 2.5
Energy Use Comparison Between
Condominium and Rental Averages

Energy Component	Condo Average ekWhr/sq.ft/ yr.	Rental Average ekWhr/sq.ft/ yr.	Condo/ Rental	Remarks*
Non-Weather Sensitive Fuel	6.95	9.62	0.72	Rentals generally have older domestic hot water systems with uninsulated pipework.
Weather Sensitive Fuel	13.98	21.25	0.66	Rentals are older buildings, mostly single glazed without heating control in suites
Base Electricity	6.16	5.23	1.18	2 rental buildings have suites independently metered. More lighting in condominiums.
Winter Extra Electricity	0.88	0.55	1.60	2 condos. have major influence on the average. Otherwise would be similar.
Summer Extra Electricity	0.81	0.27	3.00	Much more air conditioning in the condominiums.
Totals	28.78	36.92	0.78	

*Note that these remarks are not intended to be comprehensive explanations of differences, but rather contributing factors.

For fuel heated apartment buildings, the two major energy use pattern indicators from the audit are tabulated for the twenty buildings in Table 2.6. (For a reminder of the significance of these patterns, refer back to Section 2.1.) In each case, higher values for these indicators point to potential for reducing weather sensitive fuel consumption through correction of the indicated problem. Note that, although 2600 Finch was the lowest weather sensitive fuel user per sq.ft. among the rentals, it still shows a severe boiler control problem pattern. Potential for energy savings is best identified by considering both the magnitude and the usage pattern of the weather sensitive fuel component.

Table 2.6

Energy Usage Pattern Recognition

	Excessive Gas In Spring and Fall (Overheating)	Inconsistent Response of Gas Use to Weather Variations (Boiler Control Problems)	Weather Sensitive Gas Use /sq.ft. Ranking 1=highest 10=lowest
Condominiums			
2 Glamorgan	0	1	4
50/60 Inverlochy	1	1	10
50/70 Baif	0	2	9
1050 Stainton	2	1	3
1535 Lakeshore	0	2	7
1100 Caven	1	2	8
30/40 Sunrise	1	2	1
2323 Confederation	1	3	2
7811 Yonge	1	1	6
3300 Don Mills	1	2	5
Average	0.8	1.8	
Rentals			
544 Birchmount	2	2	6
First Pl. Hamilton	1	2	8
2600 Finch	1	3	10
100 Gloucester	1	2	1
3400 Keele	1	2	3
20 Esterbrooke	3	1	2
11 Dervock	0	2	9
5 Cedar	2	2	5
3400 Riverspray	2	2	4
2440 Hurontario	3	2	7
Average	1.6	2.0	

Codes: 0=No indication
1=Slight indication
2=Moderate indication
3=Severe indication

Note that these codes are applied visually rather than by rigorous mathematical analysis at this time.

2.3 WORKSHOPS

Over the six month period from December 1980 to May 1981, all significant energy using systems in the buildings were tackled. Systems which were changed in each of the buildings are showed in approximate order of return on investment in Table 2.7. Participants received clear explanations of design and operational rules and principles, guidance on how to collect necessary information about the systems, and advice on how to make modifications to reduce energy costs. At each subsequent session, new subjects would be covered, while problems and successes in implementing changes would be reviewed. In this way, participants progressively acquired knowledge and modified energy system to provide optimum energy use.

Of the twenty buildings which began the program, fourteen showed savings during the first year of the program, as recorded by the computerized energy monitoring program described in more detail in Section 2.4. First year savings are summarized in Table 2.8, together with the number of workshops attended, and an outline of changes made. There is a noticeable and understandable correlation between attendance at workshops and magnitude of savings. 3400 Riverspray showed the greatest dollar savings at $21,530, and recovered their total investment 6-1/2 times in the first year. 2440 Hurontario achieved the highest percentage savings at 13.9 percent, worth $14,560 in the first year, for an investment of only $1,250. 11 Dervock was the lowest energy user per sq.ft. among the rental buildings at the start of the program, yet achieved a 12.7 percent cost saving in the first year worth $6,630, for a total investment of $4,100. Of the fourteen buildings which succeeded in realizing savings, only three failed to recover their total investments in the first year.

The outcome of the workshops leads to the following observations on necessary ingredients for success:

Continuity - the program is seriously affected by changes in building representatives, since newcomers usually find it very difficult to make up lost ground. This problem most seriously affected condominiums, and reduced not only first year savings but also expectations for the future. Wherever possible, there should be more than one representative for each building.

Commitment - the program is unlikely to be successful without commitment from Owner or Board, and hard work from those attending the workshops. Such commitment must be obtained before the program begins.

Time Requirement - the work requires a significant amount of time. It is the consultant's responsibility to streamline the process wherever possible. It is helpful if there is more than one participant from each building to share the load. Supplementary fees payable by building Owners to management companies for energy conservation would perhaps allow more time to be made available,

TABLE 2.7

SYSTEMS MODIFIED AT THE BUILDINGS BY SEPT/1981

IN ORDER OF ESTIMATED RETURN ON INVESTMENT (1 = BEST)

	Ventilation	Heating Boilers	Heating System	Domestic Hot Water	Garage Heat&Vent	Ramp Heater	Lighting	Pool Heat&Vent.	Misc.
CONDOMINIUMS									
2 Glamorgan	3		1	2			4		
50/60 Inverlochy	1		3			2	4		
50/70 Baif	1				2	3			
1050 Stainton									
1535 Lakeshore	3		2			1			
1100 Caven									
30/40 Sunrise	2				1				
2323 Confederation	1	2							
7811 Yonge	1								
3300 Don Mills	1					2			
RENTALS									
544 Birchmount	3	2		1			4		
First.Pl. Hamilton	1						2		
2600 Finch	3	1			2	4	5		
100 Gloucester		1					2		
3400 Keele	1	2							
20 Esterbrooke	1		3	2		4			
11 Dervock		2	4	1			3		
5 Cedar									
3400 Riverspray	1	3	2	4		5			
2400 Hurontario	4	2	1	3		5			
Count	15	8	7	6	3	8	7	0	0
Average	1.8	1.9	2.1	2.2	1.7	3.2	3.4	-	-

TABLE 2.8

Summary of the Project and its First Year Results
(Buildings presented in order of first year dollar savings).

Building (R) = Rental (C) = Condominium	Total Savings* $	Total Savings* %	No. of Workshops Attended (out of 6)	Energy Conservation Action Taken
3400 Riverspray (R)	21,530	7.4	6 (Maint. Director)	. Reduced ventilation. Heating control changes. Domestic hot water control change
2440 Hurontario (R)	14,560	13.9	6 (Manager)	. Heating control changes. Boiler control changes. Reduced ventilation. Reduced ramp heat. Domestic hot water system changes.
1535 Lakeshore (C)	12,660	7.6	4 (Manager)	. Reduced ramp heat. Reduced ventilation. . Heating control changes.
50/70 Baif (C)	7,610	4.1	3 (Management)	. Reduced garage heat. Reduced ventilation. Reduced ramp heat.
11 Dervock (R)	6,630	12.7	6 (Owner)	. Heating system changes. Boiler changes. Domestic hot water system changes. Delamping.
20 Esterbrooke (R)	5,980	5.9	6 (Superintendent)	. Reduced ramp heat. Heating control changes. Domestic hot water system changes. Reduced ventilation.
2 Glamorgan (C)	5,180	4.9	6 (Manager) 6 (Board Members)	. Reduced ventilation-heating control changes. Domestic hot water system changes. Basement lighting conversion
2600 Finch (R)	5,110	7.1	6 (Manager)	. Reduced garage heat. Reduced ramp heat. Reduced ventilation. Boiler control changes.
50/60 Inverlochy (C)	3,750	2.2	3 (Manager) 6 (Board Members)	. Reduced ventilation. Reduced ramp heat. Heating control change. General lighting conversion. Reduced ramp heat.
7811 Yonge (C)	3,250	3.3	3 (Manager)	. Reduced ventilation.
100 Gloucester (R)	3,130	4.9	6 (Manager)	. Boiler control changes. Corridor lighting conversion.
2323 Confederation (C)	1,690	1.8	6 (Board Members) 3 (Management)	. Reduced ventilation. Boiler control changes
544 Birchmount (R)	1,350	1.9	5 (Manager) 1 (Superintendent)	. Domestic hot water system changes. Reduced ventilation. Boiler control changes. Corridor lighting conversion.

2...

TABLE 2.8

Summary of the Project and its First Year Results
(Buildings presented in order of first year dollar savings)

Building (R) = Rental (C) = Condominiums	Total Savings* $	Total Savings* %	No. of Workshops Attended (out of 6)	Energy Conservation Action Taken
3400 Keele (R)	930	1.0	6 (Owner) 6 (Manager)	. Reduced ventilation
1050 Stainton (C)	Unknown		1 (Manager)	. Reduced ramp heat.
5 Cedar (R)	Unknown		1 (Owner)	. Nil
30/40 Sunrise (C)	-1,010	-1.0	4 (Manager) 2 (Board Members)	. Reduced garage heat. Reduced ventilation.
3300 Don Mills (C)	-2,650	-1.7	4 (Manager)	. Reduced ventilation.
1100 Caven (C)	-3,300	-3.3	3 (Board Members)	. Nil
First Place (R)	-6,300	-2.8	6 (Administrator)	. Reduced ventilation. Delamping.

*As calculated by the computerized energy monitoring program, which compares current energy use (1980/81) with what would have been used for the same weather condition and billing periods in the comparison year (1979/80).

with potential energy cost savings far exceeding the extra management fee.

2.4 MONITOR

Cumulative savings each month for gas, electricity and electrical demand are showing graphically in Figures 2.3, 2.4 and 2.5.

First year results shown in Table 2.8 cover a period before work began in earnest (September 1980-November 1980), the period during which most implementation took place (December 1980-May 1981), and three months after implementation was generally complete (June 1981-August 1981). From trends apparent during this period, it is reasonable to anticipate substantially higher savings in the second year (September 1981-August 1982), and a second report will be prepared late in 1982 to quantify this steady state outcome of the project.

Understandably, most of the gas savings occurred between October and May. The rentals showed a fairly smooth savings pattern, peaking in January, while the condominiums showed a hiatus in February and March before recovering in April and May. The largest electricity savings occurred in the first few months of 1981, and are attributed to better control of ramp heaters. The electricity setback in February among the rentals is attributed to tenants fighting back against perhaps overzealous reduction of heating system temperatures. The overall increase in maximum monthly demand for both condominiums and rentals is disturbing and not clearly understood.

2.5 COSTS AND SAVINGS

The outcome of the first year of this demonstration project is best expressed from a financial standpoint in terms of what was spent and what was saved, and from an energy standpoint in terms of energy use per sq.ft. in the year before the project and in the first year of the project. These are presented in Table 2.9 and Figure 2.6 respectively. Since expediture on changes in a number of the buildings is continuing, and since energy results are generally improving, these two summary statements will be updated in the follow up report at the end of 1982.

FIG. 2.3

condominiums

SUMMARY OF FIRST YEAR ENERGY SAVINGS

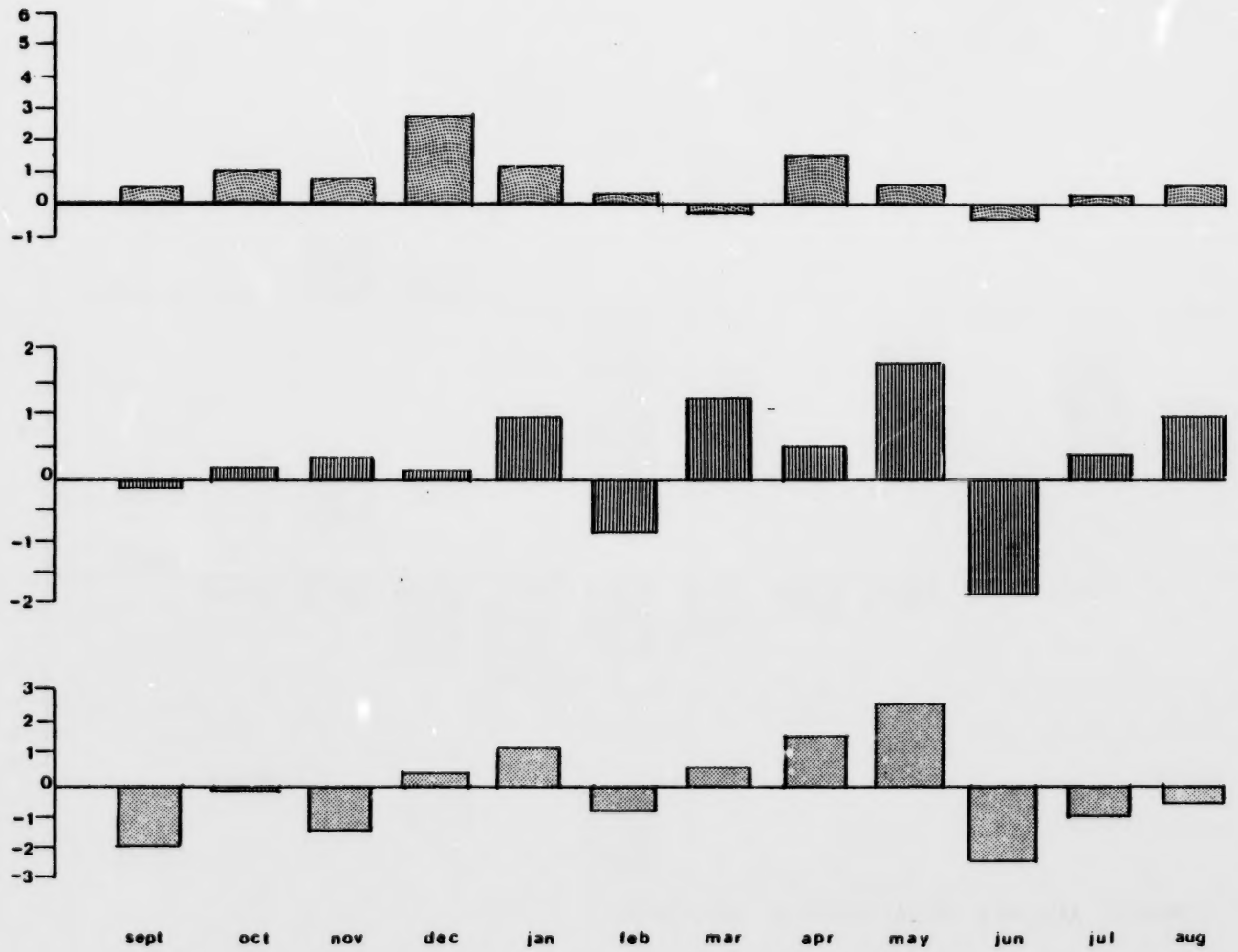


FIG. 2.4

rentals

SUMMARY OF FIRST YEAR ENERGY SAVINGS

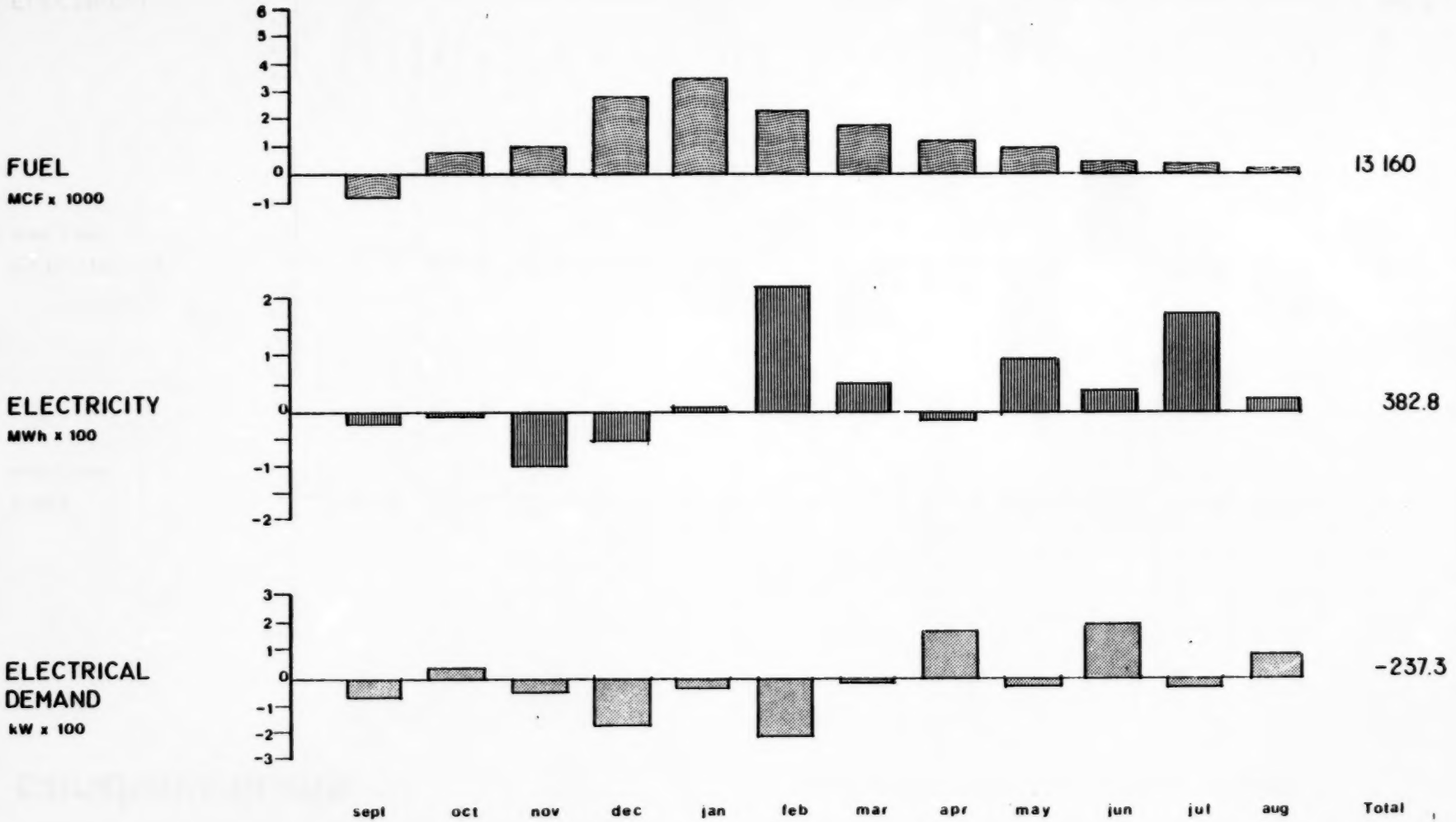


FIG. 2.5

total CONDOMINIUMS & RENTALS

SUMMARY OF FIRST YEAR ENERGY SAVINGS

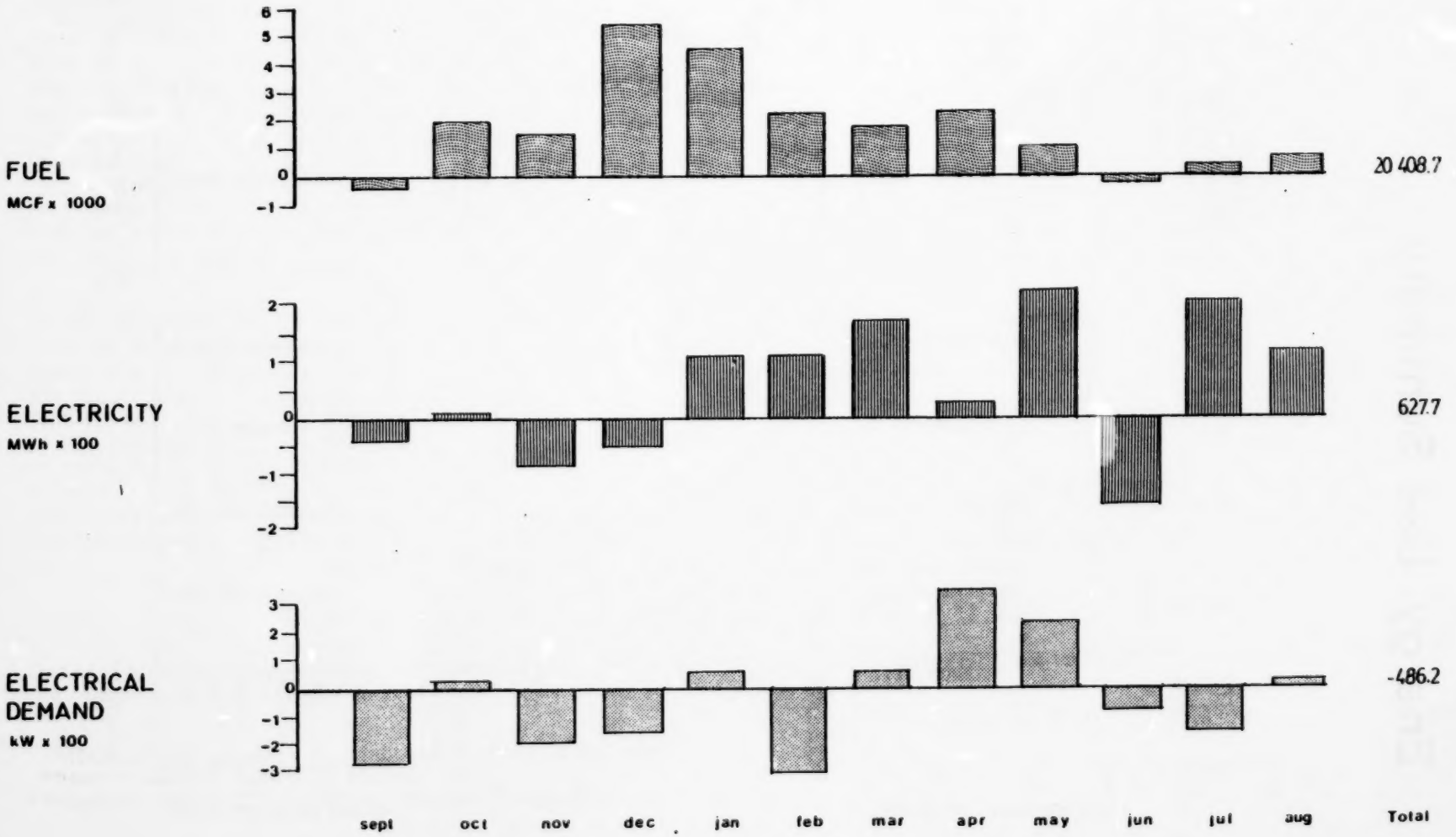
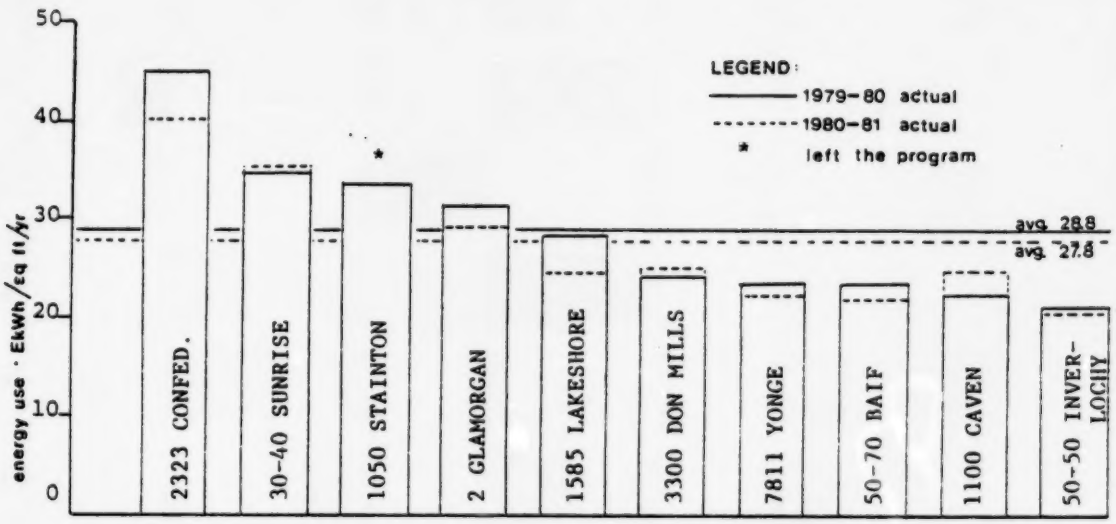


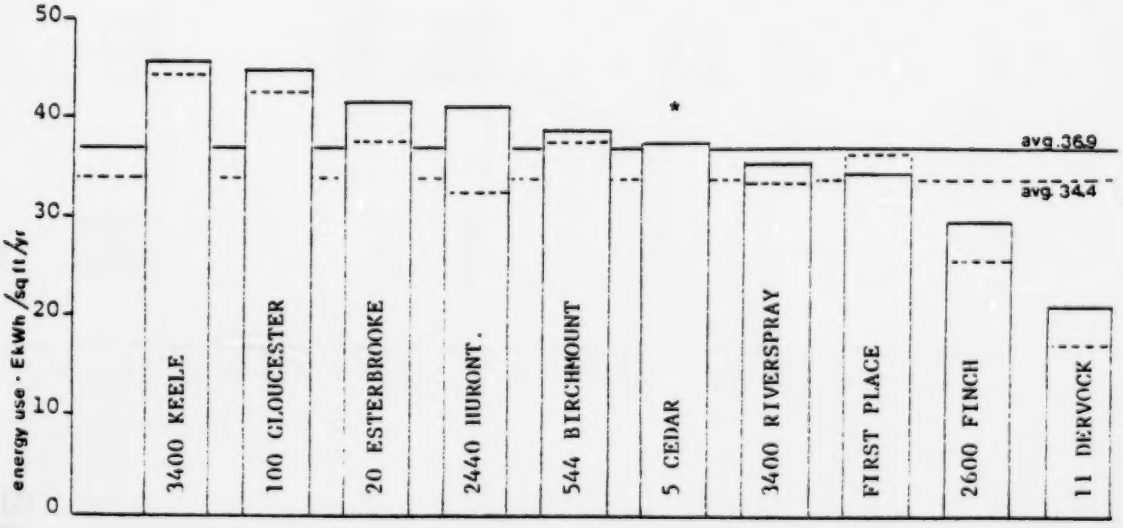
FIG. 26

Energy Use Summary



CONDOMINIUMS

7 248.7 MCF gas
244 900 kWh elec
] $28,180 aggregate first year savings



RENTALS

20 408.7 MCF gas
627 700 kWh elec
] $52,930 aggregate first year savings

TABLE 2.9

Summary of Costs and First Year Savings for the Demonstration Project

Building	Actual First Year Savings $ (1981)	---Costs--- Lighting Conversions	Ventilation*	Ramp Heater & Garage**	Boilers, Htg. Systems, DHW Systems***	Total
CONDOMINIUMS						
2 Glamorgan	5,180	200	1,450	-	1,250	2,900
50/60 Inverlochy	3,750	9,500	450	350	3,200	13,500
50/70 Baif	7,610	-	650	350	-	1,000
1050 Stainton	----------Left the Project----------					
1535 Lakeshore	12,660	-	800	100	-	900
1100 Caven	(3,300)	-	-	-	-	-
30/40 Sunrise	(1,010)	-	1,200	-	-	1,200
2323 Confederation	2,690	-	1,500	-	-	1,500
7811 Yonge	3,250	-	100	-	-	100
3300 Don Mills	(2,650)	-	650	150	100	900
	28,180	9,700	6,800	950	4,550	22,000
RENTALS						
544 Birchmount	1,350	3,000	700	-	100	3,800
First Pl.Hamilton	(6,300)	-	300	-	-	300
2600 Finch	5,110	30	345	125	-	500
100 Gloucester	3,140	3,800	-	-	-	3,800
3400 Keele	930	-	650	-	150	800
20 Esterbrooke	5,980	-	300	500	2,700	3,500
11 Dervock	6,630	800	-	-	3,300	4,100
5 Cedar	----------Left the Project----------					
3400 Riverspray	21,530	-	650	150	2,000	2,800
2440 Hurontario	14,560	-	970	-	280	1,250
	52,930	7,630	3,915	775	8,530	20,850
Totals	81,110	17,330	10,715	1,725	13,080	42,850
Consulting fees for workshops, for computerized energy audits, and for computerized monitoring of ongoing energy use for 1 year						56,000
					TOTAL COST	98,850

*Airflow measurements & adjustments, timeclocks, etc.
**Hour counters, control changes, etc.
***Control changes, insulation, piping changes, etc.

2.6 ISSUES RAISED

Interesting issues are inevitably raised when groups of people are brought together to apply their collective efforts towards a common objective, in this case energy conservation. The issues are described below in sufficient detail to allow those with merit to be taken up again in future.

a. Rent Review

Predictably, this headed the list in terms of frequency and intensity of discussion among the rental building representatives. None of the buildings on this program was expected to be subject to rent review in the foreseeable future. Nevertheless, it was made very clear that equivalent energy management activity would not take place in buildings which were likely to go to rent review, since savings achieved would be deducted from allowed rent increases, and amortization periods for capital expenditures would be likely to cause negative short term cash flows. Raised rent increase ceilings, to reduce the number of affected buildings, and accelerated write-off of energy conservation capital purchases were among the conventional proposals made to remedy the situation.

b. Ventilation Codes

There are substantial differences in both airflow and operational requirements for ventilation systems between Ontario municipalities. The energy impact of these differences is potentially very substantial, and further study was recommended to develop clear, safe and consistent rules. The Ministry of Consumer and Commercial Affairs has been asked to look into the subject.

c. Property Management

Knowledge among property managers of energy conservation and of other technical aspects of apartment building management were felt to be often inadequate by many of the participants. Increases in the number of college graduates were appreciated, but felt to be still insufficient. Registration of property managers was considered desirable, although there were conflicting opinions about whether this should be tackled by government or by the industry.

d. Laundries

It was reported that the cost of using laundry machines in most buildings has risen to 75¢, and that a large part of the upward pressure comes from increasing utility costs. Since most tenants do not pay for hot

water or electricity, the attraction of acquiring their own machines, often illicitly, is increasing. Recognizing that small machines inside suites result in higher hot water and electricity use than do central facilities, the energy impact of widespread growth in their use would be significant, and further study was recommended to monitor this effect.

e. Electricity Metering for Suites

Several studies have indicated 35 percent less electricity use in apartments where tenants pay their own electricity bills, compared with those in bulk metered buildings. Several participants strongly recommended further study into reducing installation and reading costs of meters, and modification of municipal hydro-electric utility rules to facilitate individual suite metering. Excessive light bulb wattages, lights left on all day and electric heaters or ovens used to obtain unreasonably high room temperatures were frequently cited as uncontrollable problems in bulk metered buildings.

f. Unanswered Questions

While high and low energy use can generally be explained by the nature of the building and its occupants, and by design and operation of energy systems, anomalies occasionally arise which highlight a lack of complete knowledge about energy cause and effect. From this program, we have two rental buildings which are apparently similar in age, design, construction, occupancy and operation. Yet 100 Gloucester uses almost double the fuel consumption per sq.ft. of 11 Dervock. A detailed investigation into the two buildings is recommended to establish reasons for the anomaly.